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ABSTRACT

Focusing on the acquisition of science processes, a study was made of the relationship of acculturation and social class to cognitive development among 1,677 lower and lower middle class students enrolled in the public high schools of three rural, 11 semi-urban, and three urban communities. Acculturation was defined at the community level in terms of formal education, wage employment, and urbanization. Social class was defined at the individual level in terms of father's level of formal schooling, occupational prestige, and income. As groups, students in classrooms were administered tests for about 3 hours. Measures included a standardized nonverbal intelligence scale; a group embedded-figures test; a test of the ability to make generalizations; group conservation tasks; and a test of ability to perform basic science processes of observing, comparing, classifying, quantifying, measuring, predicting, inferring, and experimenting. Three scales were developed and administered; these concerned life processes/cycles of animal and plant life, inferential reasoning about internal states of others, and natural phenomena. In addition, questionnaires on family characteristics were completed by students and parents. Among the findings was the observation that nonverbal reasoning, abstract reasoning, higher levels of development, and better understanding of science processes appear to be enhanced by more years in secondary school, membership in a social class above the subsistence level, and living in a more acculturated environment. (RH)

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MONOGRAPH NO. 34

Acculturation, Social Class and Cognitive Growth

Jasmin Espiritu Acuña, Ph.D.

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To Violeta L. Rodriguez, a colleague who shared our vision.

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With the compliments of the Director and staff
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What an amazing creature man is! For he can dream of things as they can be. Some dream of wealth, some dream of power, and still others dream of a better life for the greater majority. For those of us who dream of a life that transcends our current reality, we think that we have found a way of being faithful to our dream. We think that this work is a stepping stone to realizing that dream.

The men and women who promulgated universal education for all children had a vision. They saw a productive life through education. They saw human dignity restored to the poverty-stricken through the development of human potentials. And all of us in education share that vision. We see our roles in society as important for the preparation of the young for their roles in our community. And as we look at the eager faces of the children in our care growing up to be better persons, standing up with pride and dignity, poor but confident in their competence, we know that part of our vision is taking shape before our very eyes. This is what gives meaning to our lives and efforts.

This work is therefore a plea to try and understand the children. It is a call for listening to them and learning from them. They will provide the insights to us on how best to teach them. And we must give them room to grow. Only if they are secure in our esteem will they acquire the ability to develop intellectual honesty. Only if we let them raise their questions, even to question our authority, will they develop critical thinking. Only if we allow them to make mistakes can they learn from these mistakes and develop accuracy. Only if we present reality as a complicated, multifaceted whole can they acquire different perspectives of reality, transcend their experiences, and develop visions of their own. And finally, only if we believe in their capacities and respect their potentials for development can we expect them to remain with us long enough so that we can watch them develop human dignity.

ACKNOWLEDGEMENTS

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We are also indebted for the support and help of valuable persons outside our workgroup. Dr. Stephen T. Banta and Prof. Josefina C. Fonacier provided editorial criticisms that greatly improved our presentation. Ms. Leticia Cortes and her workgroup in Environmental Science generously shared their time to provide us not only academic expertise, but also moral support and encouragement for what at one time seemed like an endless job. Moreover, the academic ambience and professional trust at the Center allowed for the initiative and dedication of the researchers to give free expression to a multidisciplinary approach to a problem in education. And finally we are grateful to the teachers and students who have helped make our data collection a pleasure.

INTRODUCTION

The impetus for concern with poor and rural children's intellect was the desire to ameliorate their obvious school failure. No one denies that poor or rural children as a group receive low grades, score poorly on standardized tests of achievement, and leave school earlier than do middle class urban children as a group (Ginsburg and Russell, 1981). The controversy lies in the explanation of these facts. Notwithstanding the consensus in observation of rural children's achievement, a controversy arose. The controversy lies in the explanation of these facts.

One view refers to cognitive deficit. Environmentalists--defined as psychologists who explain human behavior as the result of environmental factors--say that poor children develop in a deprived environment which stunts their cognitive growth. Their environment fails to provide opportunities for them to develop those processes necessary for acquiring skills in the use of linguistic and mathematical symbols and in the analysis of causal relationships. The cognitive deficit they labor under prevents poor children from learning conceptual material taught in school.

Nativists--defined as psychologists who explain human behavior as the result of innate biological factors--postulate a cognitive deficit also, namely, an inability to engage in "conceptual learning," which involves cognitive activity mediating between stimulus and response. However, this cognitive deficit is postulated as a result of genetic inheritance.

Another group of theorists believe that poor children do not suffer from a major cognitive deficit. According to this view, evidence suggesting a deficit is faulty, as the standard tests from which the evidence is derived may be culturally biased. Adequate testing procedures would reveal cognitive differences or even strengths, not deficits.

The primary question this research addresses is: Do poor, rural children suffer from a cognitive deficit? From this endeavor we can deal with the secondary questions: If there is a deficit, what are its origins and how does it produce school failure? If there is none, what explains poor children's inadequate competence?

The first criterion for research on cognitive deficit is to place major emphasis on the examination of the cognitive processes involved in the acquisition of academic knowledge. This study focused on the achievement of science processes. General intelligence, cognitive style, level of cognitive development, and abstract thinking are assumed to be contributory to the achievement of these processes, and they have been included to identify the possible sources of differences among children in the acquisition of science processes. Science processes are assumed to be directly relevant to school performance in science.

Because of the paucity of knowledge concerning the influence of acculturation and socioeconomic status differences in the development of scientific thinking, we conducted this study. The results of the study led to the classification of communities and schools into three levels of acculturation, and students within each community into three levels of social class. The effects of years in school and of maturation (age) are related variables known to affect cognitive development, but with different implications for theory. These effects were also included in the analysis.

In short, we wanted to answer the general question: Do poor, rural children suffer from a cognitive deficit or a cognitive difference? If it is a cognitive difference, what cognitive skills are developed among the rural adolescents?

The idea that people will develop what they need in order to survive is taken from Berry's research (1976) on cognitive style. Most people in the rural areas need some understanding of life cycles and of natural phenomena. Their livelihood often depends on their comprehension of plant and animal life cycles and their understanding of other natural phenomena. In addition, inferential reasoning about emotional states of other people is important for their social life. Survival in an extended family situation and in a closely knit rural community requires social sensitivity and awareness. We assume, therefore, that these three areas--life cycle, natural phenomena, and inferential reasoning about emotional states--may capture rural versus urban and low versus middle class differences that may be different from the ones obtained through standardized tests.

Acculturation

In the present study, opportunity structure is operationally defined as a composite scale which is labeled

acculturation continuum. By means of this scale, quantification of aspects of acculturation that differ among communities was attempted (Acuña, 1980). These aspects--ten in all--form the same three clusters discussed by Berry (1976): formal education, wage employment, and urbanization. More acculturation means more urbanization. The three lowest ranking communities according to the acculturation scale were combined and called rural. The three highest ranking communities were also combined and called urban. The rest of the communities in the middle of the acculturation continuum were assumed to be in the process of urbanization, and they were called semi-urban. In using an acculturation continuum prior to classification, we have move away from an impressionistic judgment towards approximate quantifiable ways of comparing communities with each other. The quantification of acculturation was based on group means of student personal data and students' responses within communities. For example, the average education of fathers in a community was used as an index that was then used as the basis of ranking. Ranks of these ten aspects were then combined to compute for the final rank, which was the basis for the acculturation continuum. Rank on the acculturation continuum used as a unit of analysis glosses over individual differences within a community. The assumption embedded in this type of analysis is that some socio-cultural factors that influence development are shared by members of a community. The study hopes to clarify how these factors are related to cognitive development.

Social Class

This study also related social class with cognitive development. Social class is arrived at through a socioeconomic status (SES) index. This variable is different from the acculturation index in that, within a community individual members may belong to different social classes. As a variable, therefore, social class is at the individual level while acculturation is at the community level.

Acculturation and social class are viewed as related variables. Poverty restricts one's mobility and limits one's opportunities. But poverty exists in both the rural and the urban areas, and children from public schools would more likely be from poorer families.

Social class and the socioeconomic status index are both based on education, occupation and income. The education factor is based on the father's level of formal schooling. Occupation is taken from a ranking of occupational prestige. Income categories are based on the

social indicators ov poverty derived from Mangahas' study (1976). From these factors, low, low middle, and middle class classifications were formed.

The intention is to relate acculturation and social class with cognitive development. Because the study was naturalistic rather than experimental, there was a difficulty in finding middle class subjects in remote rural areas. The choice was either to ignore the small middle class rural sample or to artificially move into semi-urban communities where there were enough of the middle class families. We chose the former. It is a reality that middle class families are rarely found in remote rural communities and that poverty may be more intense among the rural sectors or our society. The decision to reflect reality more accurately rather than present a neat experimental design which is removed from reality was motivated by the desire to understand the actuality of the Philippine environmental context.

METHODS

Communities

Selection of the communities was based on acculturation. The researchers wanted to extend the elementary level study done previously and so selected the schools attended by the siblings of the elementary school sample. This enabled the research group to fill the gap between the two ends of the acculturation continuum represented by the rural and urban communities. The assumption that most communities would be in the process of acculturation due to the extensive government road and electrification projects was validated by the preponderance of semi-urban communities in the sample.

Subjects

Since the effects of poverty and acculturation are the most documented factors depressing cognitive development, the sample for this study consisted of poor students enrolled in public schools, where fees are minimal. These poor students lived in relative degrees of environmental deprivation according to the level of acculturation of their immediate community.

Representativeness for this study is in terms of the relation of the sample individual and the community he or she is supposed to represent, not the entire student population of the Philippines. The aim was to identify the relation of acculturation and poverty to cognitive development, not to represent the entire Philippine population. However, it is inevitable that this relation will have important implications for

Philippine education in general, since the large majority of the student body in the Philippines is either poor or from deprived communities.

In most cases there was only one class (section) for each of the four years of secondary school. In other cases there was more than one class and the middle section was selected to represent the population of students from the given community. The number of subjects in each group is given in Table 1.

Table 1: Acculturation

Social Class	Rural	Semi-Urban	Urban	Totals
Low	268	524	160	952
Low Middle	63	324	212	599
Middle	8	70	48	126
Totals	339	918	420	1677

Year	Rural	Semi-Urban	Urban	Totals
1	92	226	98	416
2	85	234	109	428
3	79	232	108	419
4	83	226	105	414
Totals	339	918	420	1677

There were three hundred thirty-nine (339) students from the three rural communities and four hundred twenty (420) from the three urban communities. The rest of the sample (918) were from eleven semi-urban communities, which were defined as being between the rural and the urban communities on level of acculturation.

There were nine hundred fifty-two (952) low class students. These students came from families with a monthly income of a thousand pesos (₱1,000) or below; their fathers either had some elementary education or were elementary school graduates; the fathers' occupations were in categories 1 and 2 on an eight-point scale of occupational prestige. (See page13 for the procedure used to categorize social class.) There were one hundred twenty-six (126) middle class students. These were students whose monthly family income was at least two thousand five hundred and one pesos (₱2,501), whose fathers had either a college diploma or some postgraduate

education, and whose fathers' occupations obtained an occupational prestige ranking of 6 or above along the eight-point scale. The low middle class group was between the low and the middle class. There were five hundred ninety-nine (599) students in this class. These were students whose fathers had from some high school to some college education, whose families had a monthly income between one thousand and one pesos (₱1,001) and two thousand five hundred pesos (₱2,500), and whose fathers' occupations fell in categories 3, 4, or 5 along the eight-point prestige scale.

There were about four hundred students in each year of high school--four hundred sixteen (416) in the first year, four hundred twenty-eight (428) in the second year, four hundred nineteen (419) in the third year, and four hundred fourteen (414) in the fourth year.

There were nine hundred forty-nine (949) female students and seven hundred twenty-eight (728) male students.

Instruments

IPAT. To describe the students' native potential, a standardized nonverbal intelligence scale by Cattell and Cattell (1973) known as the IPAT (Institute of Personality and Ability Testing) was used. A score on this test was taken to be indicative of nonverbal reasoning. The original scale, Scale 2, has 46 items and takes 20 minutes to administer.

GEFT. This is a group embedded-figures test developed by Witkin's group (Oltman, Raskin, and Witkin, 1971) for cognitive style or field-dependent-independent behavior. A person's reliance on internal references (field independence)or his reliance on external references (field dependence)as a guide to his behavior is assumed to be at the heart of this dimension. Cognitive style has implications for preferred learning styles. A child who is field dependent would respond more readily to a warm, personalistic style of teaching. A child who is field independent would be capable of learning best in an impersonalistic, task-oriented learning situation. While it is most desirable to develop flexibility in fulfilling the demands of varied social situations--which may require sometimes personalistic and sometimes impersonal responses, for good performance in science and mathematics a field independent style may be advantageous. Independent, analytical thinking that is not affected by personal relations may be an advantage for students of science and mathematics. This is assumed to be related to critical thinking. And a socially adept, field dependent student may find the sterile laboratory environment stifling and unsatisfying.

TAT (Test of Abstract Thinking). To describe an aspect of abstract reasoning, namely, the ability to make generalizations, the U.P. Science Education Center developed a test of abstract thinking from the logic of Shipley's tests with the same name. A series of examples is presented for each item on this test, and the students are required to extract a pattern or a rule from the examples and to demonstrate the use of this pattern or rule to extend the examples. There are 30 items on the final scale of the test, and it takes 10 minutes to administer the test. The split-half reliability was computed at .70.

Task II. This is a group task adapted from Adey's (Shayer, 1980) work with the Concepts in Secondary Science and Mathematics Project (CSMS) at Chelsea College, University of London. It is a group demonstrated task on conservation of volume and heaviness. It classifies students into different stages of development: preoperational, low and high concrete operational, and low formal operational, with two transition stages, one between the preoperational and concrete operational stages and one between the concrete operational and formal operational stages.

PTSP. The Perez Test of Science Processes (Perez, 1978) measures the student's ability to perform the basic science processes of observing, comparing, classifying, quantifying, measuring, predicting, inferring, and experimenting. Since the aim of science teaching is the learning of these basic processes, it is appropriate that the processes, rather than a test of information, be the focus of our science achievement test.*

Causation and Inferential Reasoning Scales

Three scales were developed from a previous study on cognitive growth. These scales are life processes/cycles of animals and plants, inferential reasoning about internal states of others, and natural phenomena.

Each scale is composed of a set of interrelated open-ended questions developed from a previous study (Acuña, 1980). The responses to each question is scored according to the level of accuracy and complexity of the students' responses. The scores ranged from 1 to 4, based on a hierarchy of stages of reasoning about the

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*Refinement in the development and revision of this test is available in her unpublished dissertation and test manual. Originally intended for the elementary level this test was extended upward and revised to include processes at the secondary level.

concepts; four (4) being the most accurate and one (1) being the least correct.

For example on the life processes/cycle the questions were on the causation of life, growth, birth, sickness, and death. The questions were:

(1) What is the criterion for saying plants are alive?
(2) What makes plants grow?
(3) What is the origin of plants?
(4) Why do plants get sick?
(5) Why do plants die?

Inferential reasoning is a scale with questions involving inferences about internal and emotional states of other people. The scale on natural phenomena is based on questions about the water cycle, night and day, the movement of clouds, and typhoons.

The open-ended question format, short of a clinical interview, was deemed the closest way one can get at the child's structure of reasoning. These scales are therefore different from the standardized tests in this regard. It gives the children who are unexposed to the usual testing format a chance to perform as well as the children exposed to standardized tests.

Procedure

Students were given group tests in the classroom for about 3 hours. Questionnaires on family characteristics were completed by the students and parents within the week of the test administration. Since the communities selected for this study were very similar to those selected for the elementary level, validation of unclear responses was minimal.

Social Class

Social class was based on a socioeconomic index derived from three factors; education, occupation, and income.

For the first factor in the SES index, education, the categories are in terms of years of formal schooling. Although information was collected for both parents, the father's educational attainment is more closely related to the family's quality of life, assuming that the father is the major breadwinner. The first factor for the SES index therefore comes from the father's level of formal education. In this classification, the lowest category is 1, i.e., having some

grade school, and the highest category is 7, for those with graduate level education. See Table 2 for details. The rationale behind this categorization scheme is the relative importance of certification for job placement: a higher paying job and one that is presumably more prestigious is also one that will require certification of some kind, while a lesser paying job will require less certification.

Regarding occupation, which is the second factor in this study's socioeconomic index, Mueller and Parcel (1981) recommended that occupations be rescaled for future research studies. A valid issue to consider is the outdated nature of the categories provided by Hollingshead, the limited listing of occupations, and the inappropriateness of such a list for other settings. Since Hollingshead's categories are based on only one New England community, it was quite obvious that a reclassification would have to be done for the Philippine setting. To this end, a group of graduate students in sociology doing field work outside of Metro Manila were asked to rank the occupational prestige of 58 occupations (as reported by the research sample) with job descriptions on a scale of 1 to 9. The sample was composed of secondary public school students, and none of the fathers' occupations were consistently given the highest rank of 9 by the raters. The fathers who were physicians were general practitioners, not specialists. The judges were members of the lower courts, not of the higher courts. The businessmen operated only on a small scale. ence, none of the average ratings came up to category 9 for the occupations reported in this sample.

The third factor, income, is the combined resources of the family members. The amount of income was cross-validated with the amount of reported expenditures. From responses to the questions on income, it was observed that some support came from donations and some from other family members. The reported combined family income, therefore, is the monthly estimate of all financial resources of the entire family, not just the income of the husband and wife. The lowest category (1) is ₱500 per month, and the highest category (9) is ₱4,001 and above. See Table 2 for details.

Table 2 : Socioeconomic Status Categories

Father's Education	Father's Occupation	Family Income
0 – No answer/no formal schooling	0 – No answer/none/deceased	0 – No answer
1 – Some elementary	1 – Vendor/Waiter/Barber/Beautician/Driver/ Laborer/Janitor/Fisherman	1 – 500 & below
2 – Elementary graduate	2 – Warehouseman/Bldg. Maintenance/Painter/ Sign Maker/Mailman/Farmer/Security Guard/ Cook/Baker/Tailor/Dressmaker/Carpenter/ Sari-sari Store Owner/Poultry Raising/Buy and Sell/Seaman/Machine Operator/Checker/ Detailman	2 – 501 - 1000
3 – Some High School		3 – 1001 - 1500
4 – High School graduate		4 – 1501 - 2000
5 – Some College		5 – 2001 - 2500
6 – College graduate	3 – Postmaster/Private Employee/Secretary/Clerk/ Foreman/Salesman/Sales Agent/Col. Agent	6 – 2501 - 3000
7 – Post graduate	4 – Cashier/Bookkeeper/Underwriter/Electrician/ Technician/Mechanic/Pensioner/Photographer/ Patrolman/Policeman/Taxi/Jeepney Operator/ Gov't. Employee	7 – 3001 - 3500
		8 – 3501 - 4000
	5 – Real Estate Broker/Investigator/Inspector/ Librarian	9 – 4001 & above
	6 – Marine Officer/PA or PAF Officer/Soldier/ Analyst/Agriculturist/Contractor	
	7 – Architect/Chemist/Dentist/Veterinarian/ Airline Pilot/Manager/Supervisor/Businessman	
	8 – Engineer/Lawyer/Physician/Teacher/Researcher/ Fiscal/Judge/Minister	

The poverty threshold for 1974 has been given as ₱10,550 per year in Manila, ₱8,944 per year in other urban areas, and ₱7,738 per year in rural areas (Mangahas, 1976). Therefore, the monthly subsistence level of existence was estimated at ₱875 in Manila, ₱737 in other urban areas, and ₱645 in the rural areas for 1974. For 1980-81, during the data collection for this study, it was decided to categorize low class families as those whose monthly income ranged from ₱1,000 and below. Middle class families were those with incomes of ₱2,501 and above. And families whose incomes were between ₱1,001 and ₱2,500 belonged to the low middle class subgroup. The estimate is rough and is based on the Mangahas study.

The category scores on the three factors--occupation, education, and income--were added and the raw scores were grouped into categories to constitute the SES index. The lowest category of the SES index corresponds to category 1, the highest to category 7. Category 1 of the SES index was made up of students who got a combined score of 3, which is interpreted as receiving 1 on all three indices of occupation, education, and income. Category 2 of SES was comprised of students who got combined SES scores of 4 to 6, and so on. The majority of the subjects (78.4%) were in the lower three categories, so one can safely say that the study is on lower class families in the Philippines.

From the SES index scores of 1 to 7, the lowest two categories (1 and 2) were collapsed to form the low class. See Table 3. The highest two categories

Table 3: Derivation of Social Classes from Socio-economic Status Index Categories

SEX Index Categories	n	%	Social Class	%
1	566	33.8	low	65
2	520	31		
3	228	13.5	low middle	26
4	92	5.5		
5	123	7.3		
6	116	6.9	middle	9
7	31	1.8		
Total	1676			100

(6 and 7) were also collapsed to form the middle class. And the three SES categories in between (3, 4, and 5) were collapsed to form the group between the middle class and the low class, which we labeled low middle class.

The present study allows for SES variations within communities. The unit of analysis for SES, or social class, in this study is the individual student's family.

Data Analysis

Data analysis was done two days. Stepwise multiple regression analysis was used to determine the relative importance of five independent variables in explaining the data set. The five independent variables were acculturation, social class, years in school, age, and sex. A multifactor ANOVA was used to determine the significance of the interaction effects of the variables selected through the regression analysis. Main effects were interpreted in the context of the significant interaction effects.

RESULTS

Table 4 summarizes the multiple regression analysis for the different cognitive tests and tasks. A fuller analysis is available in another report (Acuña, 1983), and only the highlights are summarized for this paper.

Variation on nonverbal reasoning can best be explained by a combination of the level of acculturation of the adolescent's community, the number of years in secondary school, and the family's social class membership. As a rule, more years in secondary school, higher social class, and living in a more acculturated community are associated with better performance on a test of nonverbal reasoning. See Figure 1.

Social class membership, years in secondary school, and sex are related to an adolescent's cognitive style. Specifically, middle class membership, more years in school, and being male are related to a more analytical, impersonalistic, task-oriented (field independent) behavior as they acquire more education, but boys develop this more abruptly while girls develop it more gradually. See Figure 2.

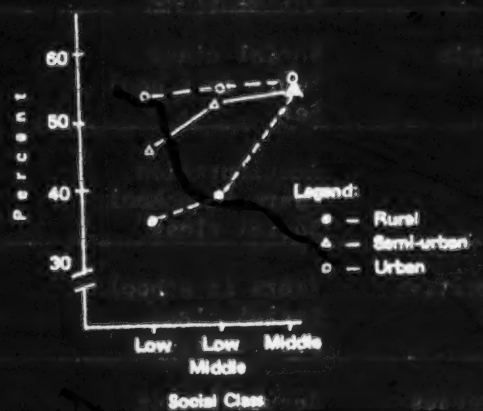

FIGURE 1. Non-Verbal Reasoning by Acculturation by Social Class

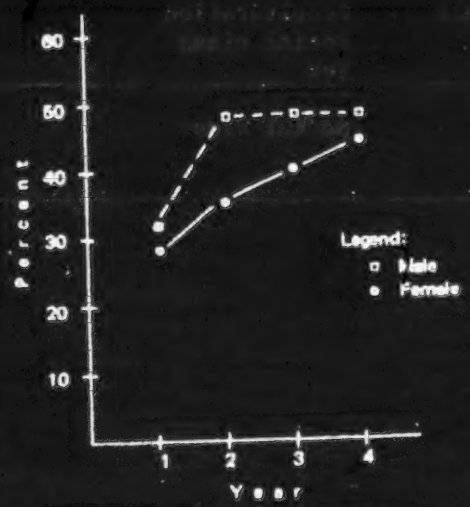

FIGURE 2. Cognitive Style by Year by Sex

Table 4: Multiple Stepwise Regression Analysis

	Variables	Multiple R
A. Non-verbal Reasoning	Acculturation	.32
	Years in school	.42
	Social class	.45
B. Cognitive Style	Social class	.23
	Years in school	.29
	Sex	.32
C. Abstract Reasoning	Acculturation	.31
	Years in school	.43
	Social class	.47
D. Level of Cognitive Development	Years in school	.28
	Social class	.32
	Acculturation	.35
E. Science Processes	Acculturation	.35
	Years in school	.43
	Social class	.47
F. Life Processes/Cycle in Plants and Animals	Acculturation	.15
	Sex	.17
G. Natural Phenomena	Acculturation	.09
	Social class	
	Sex	.12
H. Inferential Reasoning	Social class	.06

Low class adolescents living in the rural areas were not able to attain abstract reasoning, even in fourth year. But the middle class subgroup members, after first year, were able to attain abstract reasoning wherever they lived. In a semi-urban community higher social class membership was associated with earlier acquisition of the ability for abstract reasoning. The middle class semi-urban sample attained abstract reasoning in the second year; the low middle class semi-urban sample in the third year; and the low class semi-urban sample in the fourth year. See Figures 3 and 4. Thus it seems that the combined effect of being poor and living in a rural environment is related to an inability to develop abstract reasoning, even with secondary schooling.

More years of secondary school, middle class membership, and living in an acculturated community are associated with a higher level of cognitive development. See Figure 5. More of the fourth year students and less of the first year students were at higher stages of development--the high concrete operational stage, the transition stage to formal operations, and the low formal operational stage. See Figures 6 and 7. More of the middle class sample were also at these higher stages of cognitive development than the low class sample. And more of the urban and semi-urban sample were at the high concrete operational stage, while more of the rural sample were at the transition to concrete operational stage.

Understanding of science processes was enhanced by living in a relatively more acculturated community, by more years in secondary school, and by membership in the middle or low middle class. The combination of living in a rural community and being poor is associated with lower acquisition of the scientific processes that are essential for science and mathematics achievement. See Table 5. Using the 50 percent criterion for acquisition, observing, classifying, quantifying, and measuring were processes achieved by students even in first year. Comparing is a process achieved only by third or fourth year students, and predicting is achieved only by fourth year students.* Inferring and experimenting are processes that are not achieved even by fourth year students. In general, more years in school enhance understanding of science processes.

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*Comparing is a process that needs further attention. It was thought that comparing is a low level process, but it seems that it may be more difficult than the other low level processes of observing and classifying.

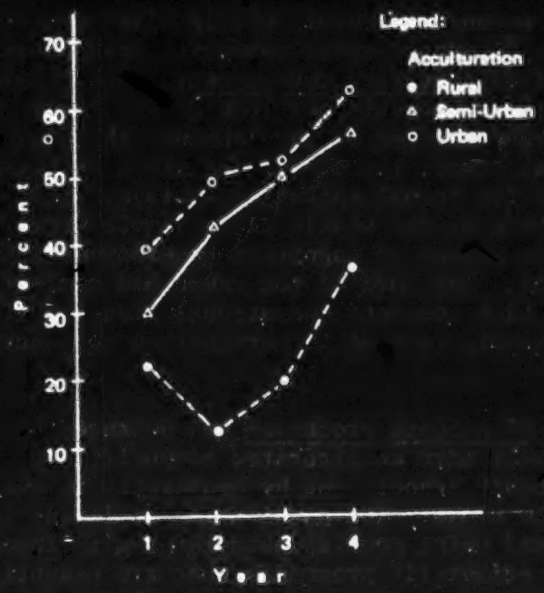

FIGURE 3. Abstract Reasoning by Acculturation by Year

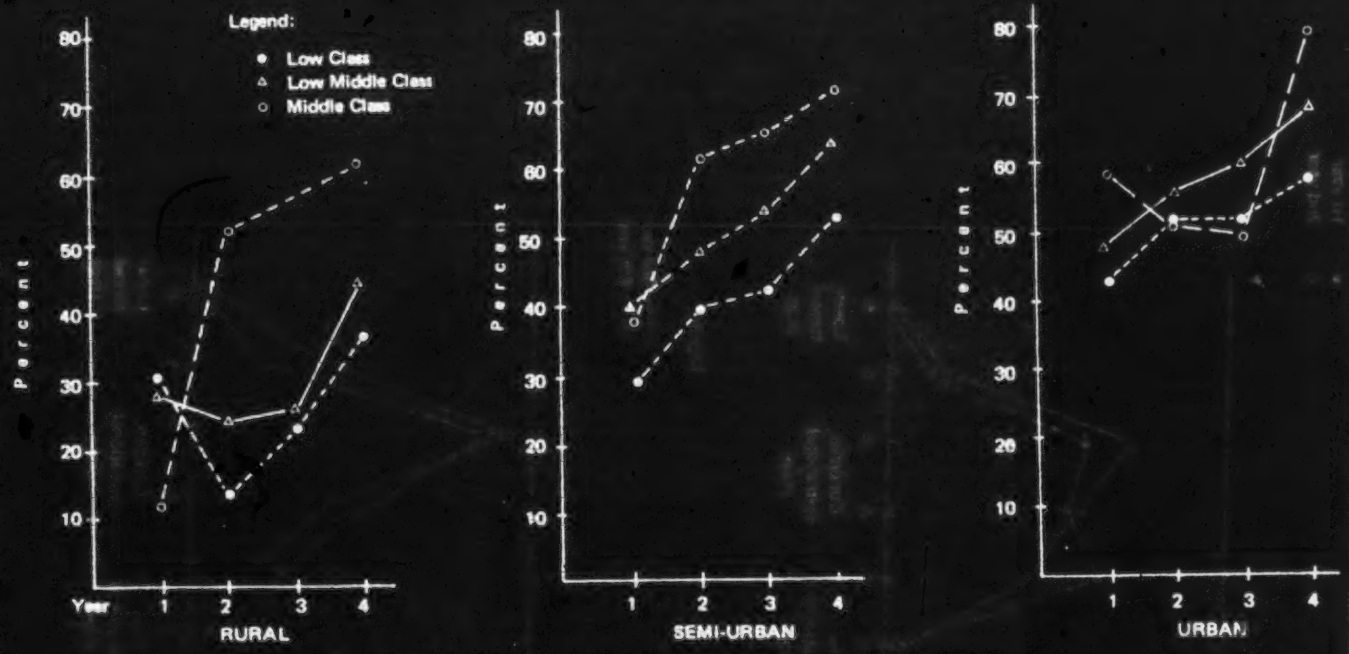

FIGURE 4. Abstract Reasoning by Acculturation by Social Class by Year

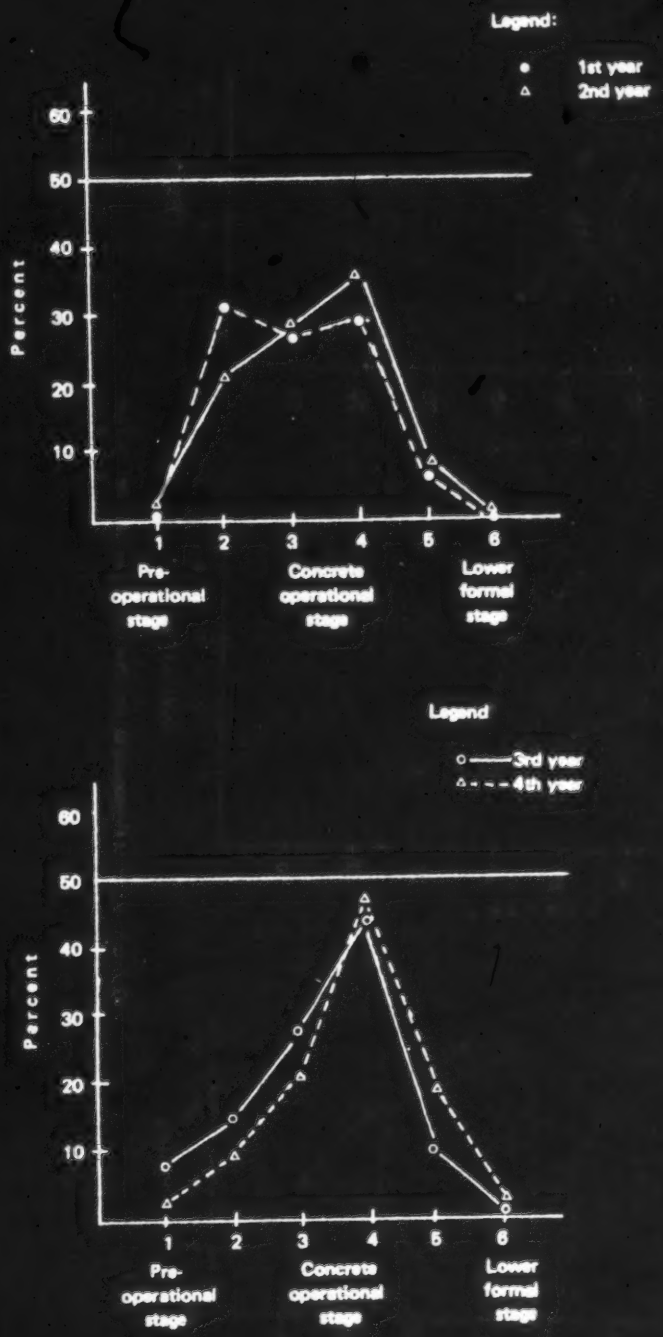

FIGURE 5. Level of Cognitive Development by Year

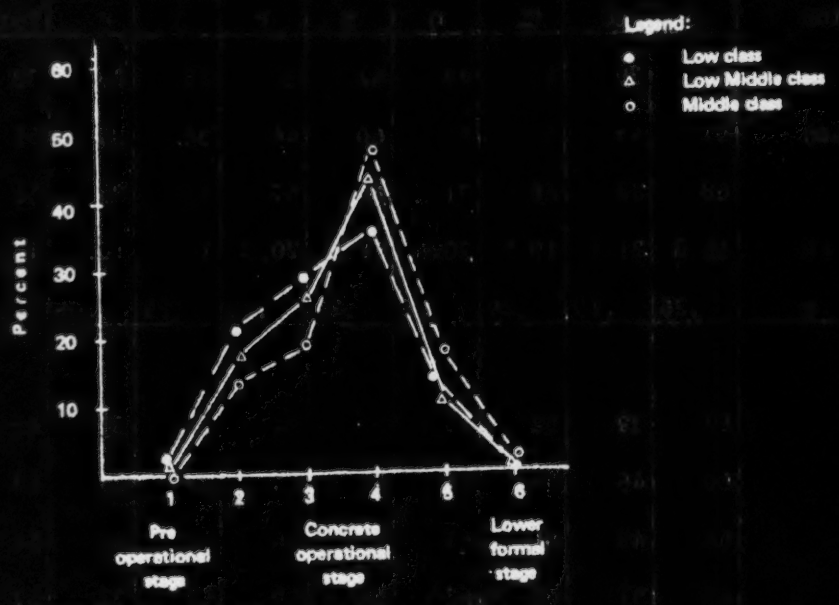

FIGURE 6. Level of Cognitive Development by Social Class

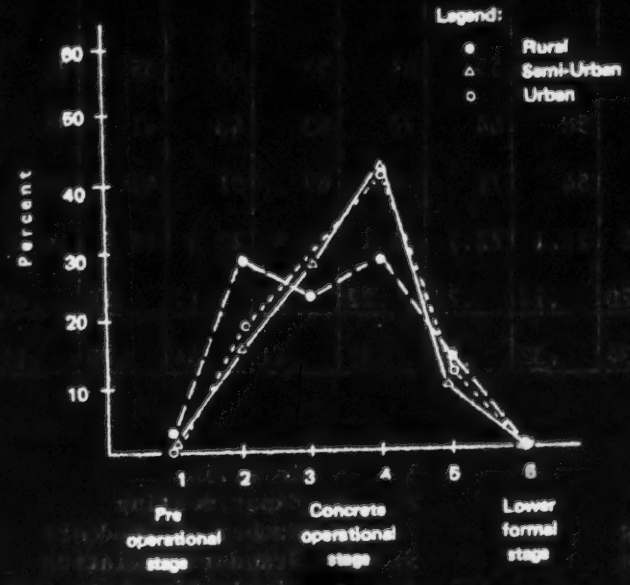

FIGURE 7. Level of Cognitive Development by Acculturation

Table 5: Science Processes

Acculturation	O	CO	CL	Q	M	P	I	E	Total	N
Rural	47	39	43	49	42	30	28	29	38	339
Semi-urban	61	45	60	63	60	44	38	35	51	918
Urban	68	52	66	71	65	47	43	35	56	419
SD	19.8	21.1	19.5	20.6	18.9	20.3	18.1	16.1	16.4	1676
r	.26	.19	.29	.26	.29	.23	.22	.08	.35	
Year/Level										
1	53	39	52	55	50	34	32	31	43	415
2	60	46	58	62	55	44	37	35	50	428
3	64	49	61	63	61	46	39	33	54	419
4	65	51	65	68	65	50	42	37	57	414
SD	21.5	21.1	22.1	24.1	20.8	23.3	18.8	16.3	16.4	1676
r	.17	.19	.21	.16	.24	.21	.17	.08	.26	
Social Class										
Low	56	43	55	61	53	40	35	33	47	952
Low Middle	67	50	64	72	63	48	41	35	55	599
Middle	70	54	71	78	67	51	43	34	58	125
SD	21.5	21.1	22.1	24.1	20.8	23.3	18.8	16.3	16.4	1676
r	.20	.19	.22	.22	.24	.17	.16	.01	.26	
MR	.34	.32	.39	.35	.41	.34	.30	.11	.47	

Legend:

O = Observing
CO = Comparing
CL = Classifying
Q = Quantifying
M = Measuring
P = Predicting
I = Inferring
E = Experimenting
N = Number of students
SD = Standard Deviation
r = Simple bivariate correlation
MR = Multiple correlation

And while even rural, poor students have some of the science processes, the gap between the rural poor and the urban middle class widens through the years in secondary school.

Living in an urban area and being female are associated with a better understanding of life processes in animals and plants, but what is amazing is that all the subgroup means were in the upper quartile range. See Table 6 and Figures 8 and 9. This means that the female rural adolescent has a level of understanding of life processes comparable to her urban counterpart.

Understanding natural phenomena seemed to be enhanced by living in a rural area, belonging to a low class family, and being male. See Figures 10 and 11. The rural, poor adolescents had a good grasp of natural phenomena processes. All subgroup means were in the upper quartile range except that of the rural middle class.

And finally, inferential reasoning about emotional states was very well developed among all the sample subgroups. See Figure 12. It seems that the sample learned to infer at least the emotional and internal states of other people, a skill which is assumed to be related to social awareness and social sensitivity, no matter where they resided and whatever their social class membership. But inferential reasoning associated with science teaching involves inference in purely logical, objective, scientific situations. And we do not yet know how to nor even if we can bridge the gap from social inference to developing inference as a scientific process.

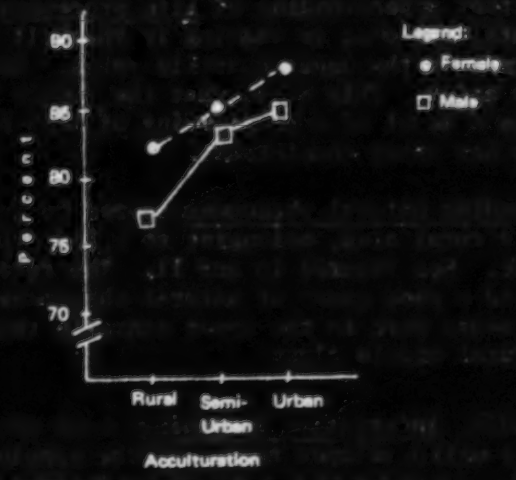

FIGURE 8. Animal Life Cycle by Acculturation by Sex

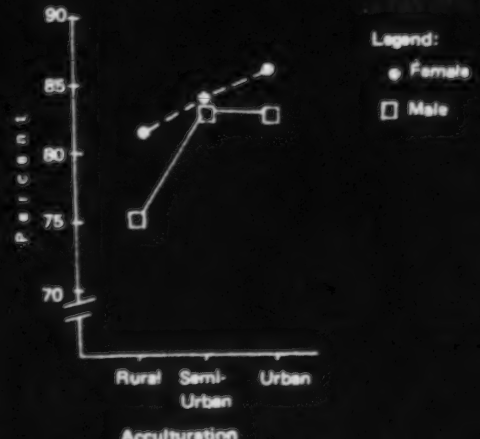

FIGURE 9. Plant Life Cycle by Acculturation by Sex

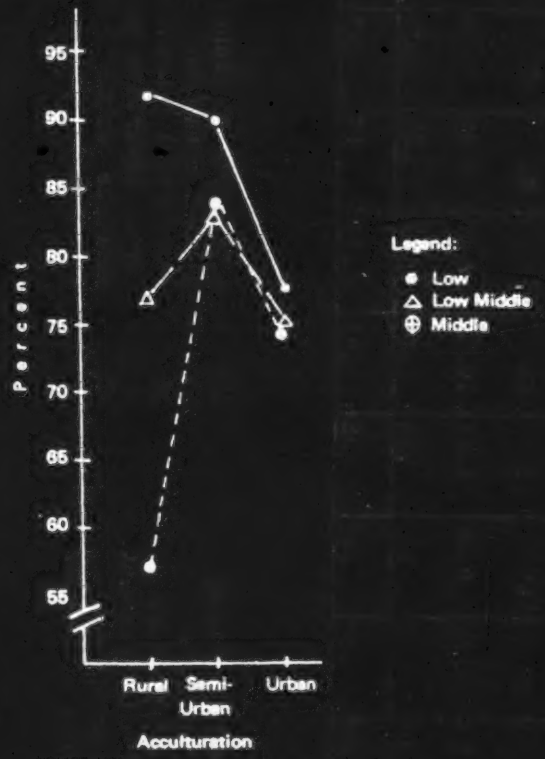

FIGURE 10. Natural Phenomena by Acculturation by Social Class

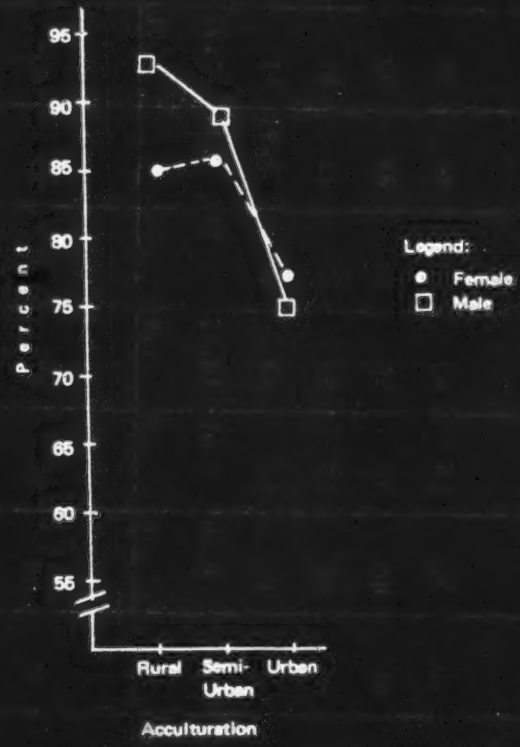

FIGURE 11. Natural Phenomena by Social Class by Sex

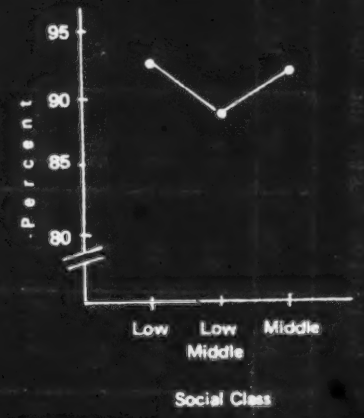

FIGURE 12. Inferential Reasoning by Social Class

Table 6: Cognitive Tests and Scales

Acculturation	NR	CS	AR	CD	SP	LCA	LCP	NP	IR
Rural	37	28	23	53	37	80	78	89	86
Semi-urban	48	40	47	58	53	84	83	87	96
Urban	54	44	53	58	58	87	85	76	88
SD	6.98	6.21	8.34	1.01	16.42	2.82	2.91	9.75	3.80
r	.32	.15	.32	.03	.35	.16	.15	.09	.004
Year Level									
1	41	28	30	50	43	82	80	82	89
2	46	40	40	55	50	85	83	89	93
3	48	44	47	57	54	85	83	87	92
4	54	44	47	63	57	84	2.91	81	93
SD	7.51	6.21	8.34	1.01	16.42	2.82	.06	9.75	3.80
r	.26		.30	.26	.26	.05		.01	.03
Social Class									
Low	43	32	37	56	47	83	82	89	93
Low Middle	52	44	50	58	56	84	83	80	88
Middle	54	52	57	62	60	87	86	78	92
SD	7.51	6.21	8.34	1.01	16.42	2.82	2.91	9.75	3.80
r	.23	.23	.26	.13	.26	.05	.07	-.09	-.03
MR	.45	.32	.47	.35	.47	.19	.17	.12	.06

Legend:

NR = Nonverbal reasoning
CS = Cognitive style
AR = Abstract reasoning
CD = Cognitive development
SP = Science processes
LCA = Life cycle of animals
LCP = Life cycle of plants
NP = Natural phenomena
IR = Inferential reasoning
r = Simple bivariate correlation
MR = Multiple correlation

SUMMARY AND CONCLUSION

In summary, consistent with expectations, nonverbal reasoning, abstract reasoning, higher levels of cognitive development, and better understanding of science processes seem enhanced by more years in secondary school, membership in a social class above the subsistence level, and living in a more acculturated environment. These tests and tasks reflect the formal skills developed in the schools. For these tests and tasks the rural low class adolescent seemed deprived, performing at a level lower than the urban or middle class adolescents.

Moreover, middle class membership, more years in school, and being male were found to be related to more analytical, impersonalistic, and task-oriented behavior. Both male and female adolescents develop more field independent behavior as they acquire more education, but boys seem to acquire this development more abruptly, while girls develop it more gradually.

However, three scales constructed from interview questions had very different trends from these standardized cognitive tests and tasks. These scales were on understanding the life cycle of plants and animals, natural phenomena and inferential reasoning. The sample students generally scored very well on these scales. Most of the subgroup means were in the upper quartile, which was interpreted to mean that the sample had a very good grasp of the concepts involved.

For the scale on life processes in plants and animals, acculturation and sex explained most of the variation in the data. Although urban adolescents were generally doing better than the rural adolescents, for some reason females were doing better than the males. However, for the scale on natural phenomena, the effect of acculturation and social class is reversed. Poor, rural adolescents have a better comprehension of natural phenomena than their urban and middle class counterparts. This scale was therefore taken to capture an aspect of cognition that is well developed in the rural, poor adolescents.

And finally, no significant differences attributable to acculturation and years in school have been found on inferential reasoning about emotional states. Adolescents developed inferential reasoning about emotional and internal states of other people wherever they lived, and more years in secondary school did not enhance this. This result could very well be explained by a ceiling effect, that is, adolescents develop this particular skill to its maximum regardless of their environment and even before they reach high school, such that any improvement in this area will not be as marked as they would otherwise be. On the other hand, it is also possible that this skill, which is assumed to be related to developing

social awareness and interpersonal sensitivity, may not be directly addressed by most public schools. The family's social class membership had a significant but slight effect on this scale. The low and middle class adolescents are slightly superior to the low middle class group.

In conclusion, this research meant to explore areas of cognitive development that are affected by schooling, acculturation, and social class. The thesis of the study is that the adolescents who are living in rural areas may have certain advantages that the modern day school system has failed to integrate within its curriculum. This contention seems supported by the study. Although standardized tests and tasks have consistently favored urban, middle class adolescents, some scales developed from interview questions related to natural phenomena and inferential reasoning have shown either a distinct rural, low class advantage or at least have not shown the usual urban, middle class advantage. In this way at least part of what develops in the rural poor adolescents seems to have been documented.

So What's New?

This study has documented some of the cognitive skills and abilities of rural, poor adolescents. It implies that the cognitive deficit hypothesis may be inappropriate in explaining the poorer academic performance of the rural poor. The cognitive difference of rural, poor students entails a commitment on the part of educators to utilize the existing cognitive skills in these students to effectively transfer these skills to school learning situations. The commitment of the educator to develop these students will require innovative teaching strategies and more relevant examples to bring the school learning experiences in touch with the students' sociocultural environment.

Figures 13 to 18 summarize the cognitive tests and tasks by acculturation, years in school, and social class membership. Using the 50 percent criterion cut-off for attainment, the results of this study show that the rural children did not acquire nonverbal reasoning, abstract reasoning, and a more field independent style of responding, all of which are required for good performance in school science and mathematics. (See Figure 13.) These same rural adolescents were not as competent as their urban counterparts in understanding the different science processes, but they had acquired at least two of these science processes--quantification and observing (see Figure 14; the mean of the rural subgroup for observing and quantifying is not significantly different from 50 percent). Moreover the rural adolescents (see Figure 13) have a high level of

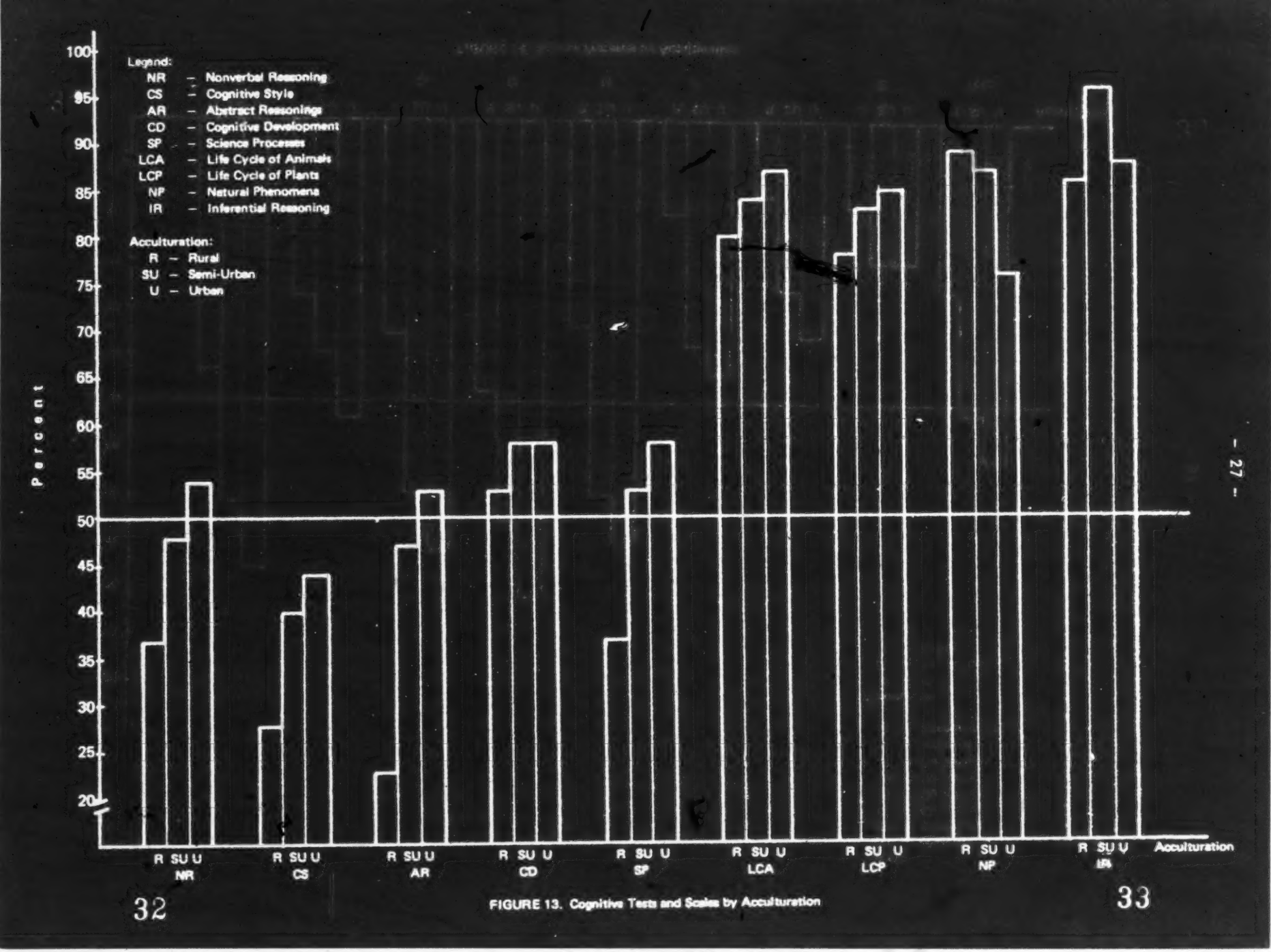

FIGURE 13. Cognitive Tests and Scales by Acculturation

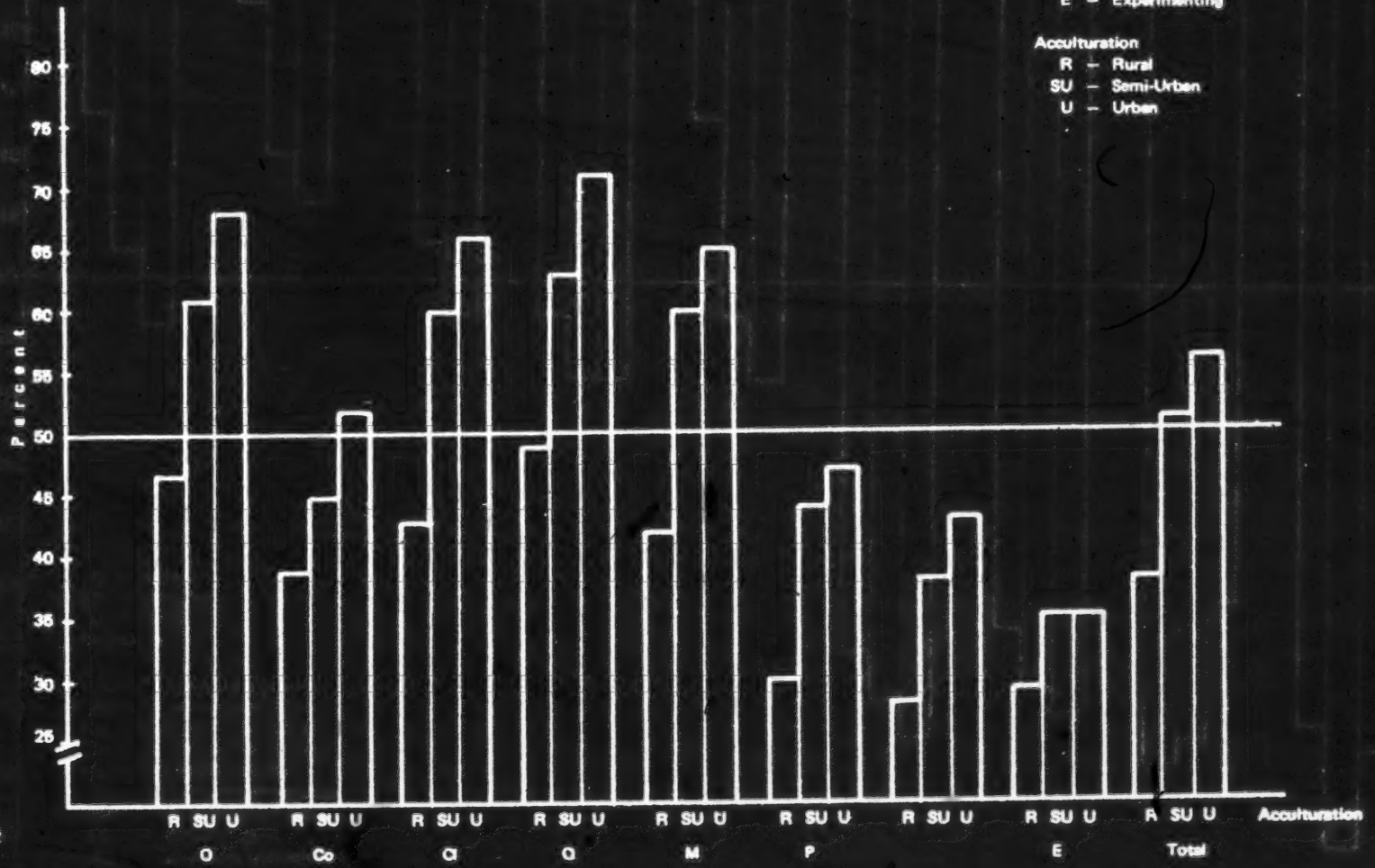

FIGURE 14. Science Processes by Acculturation

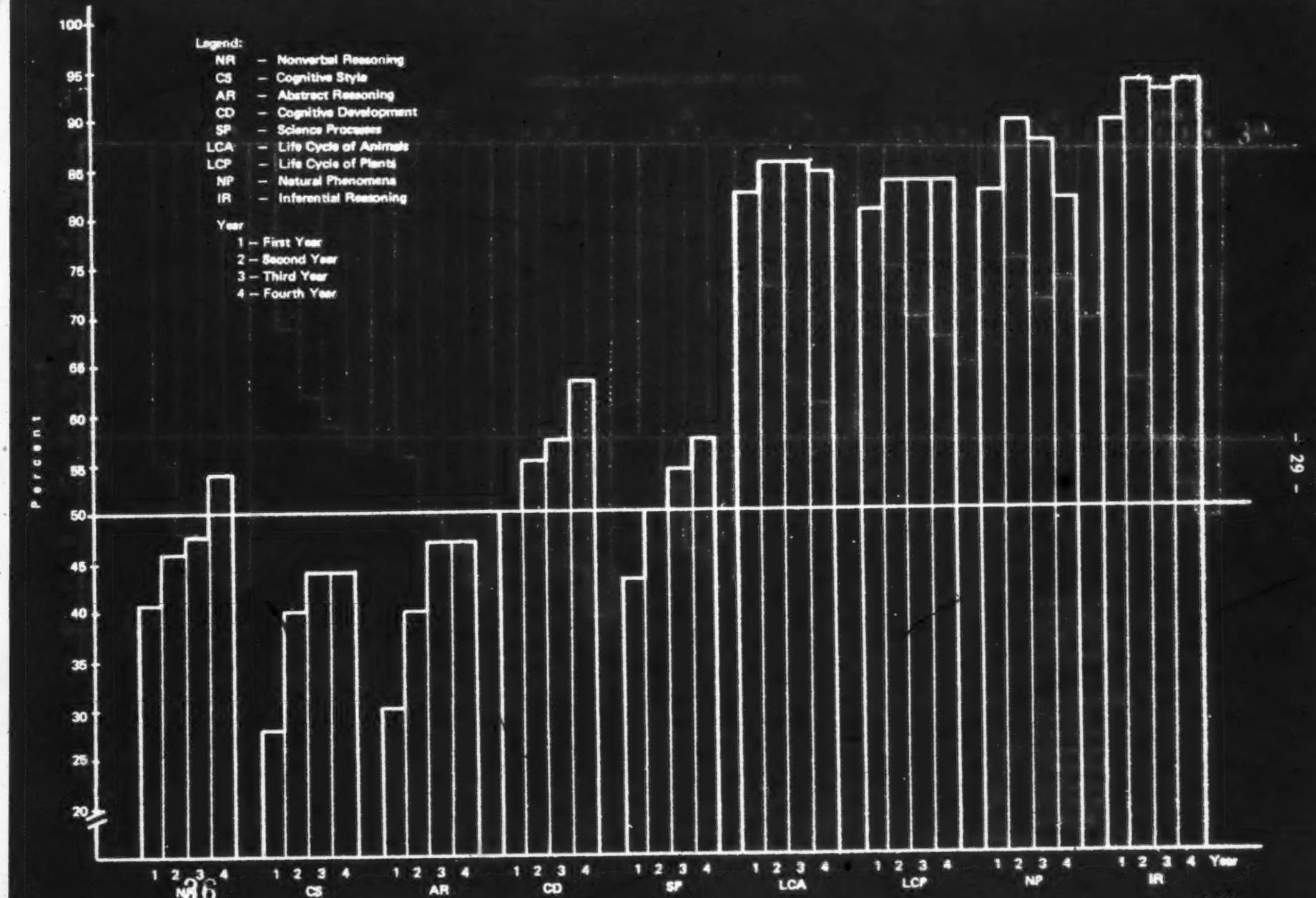

FIGURE 15. Cognitive Tests and Scales by Year

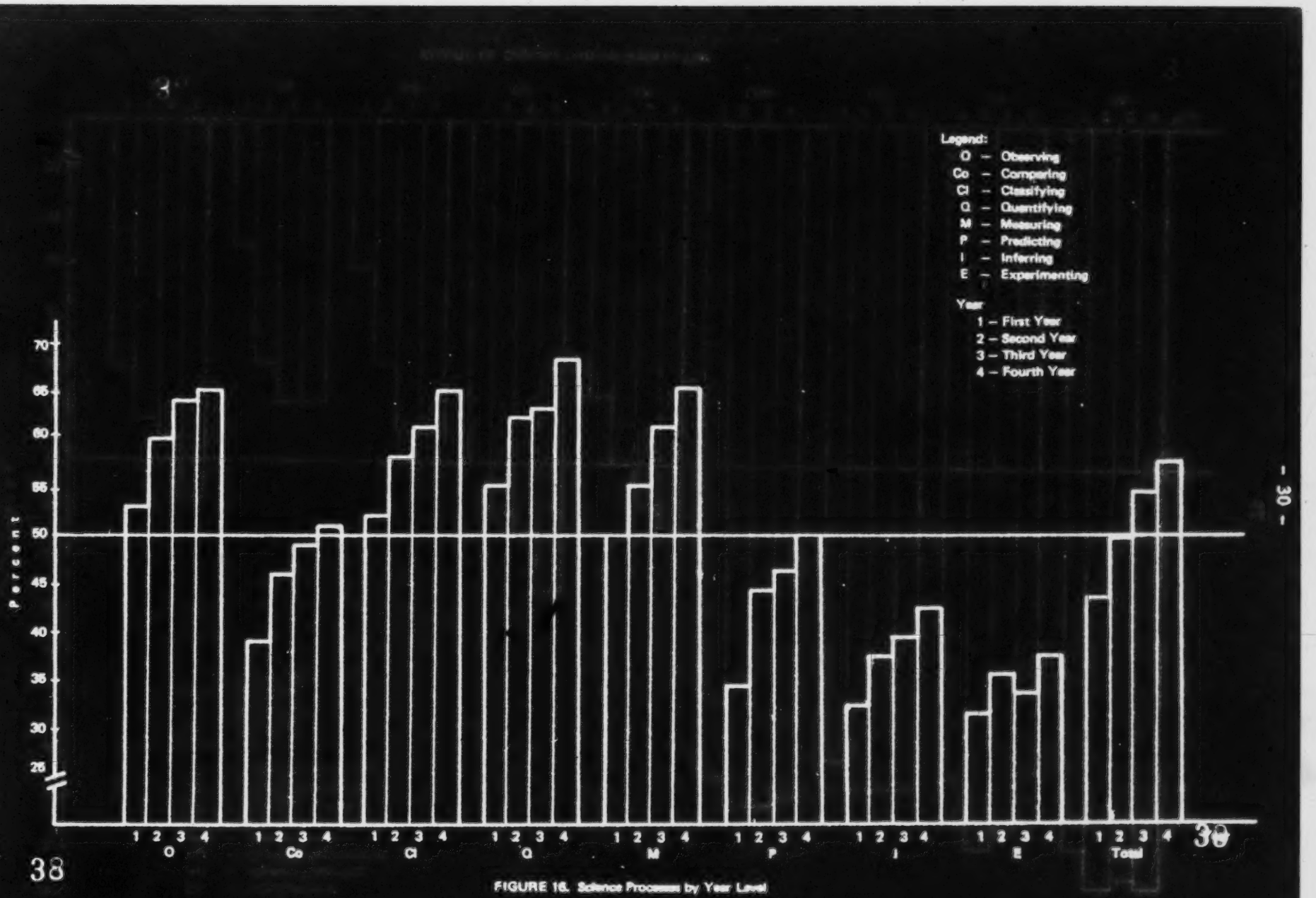

FIGURE 16. Science Processes by Year Level

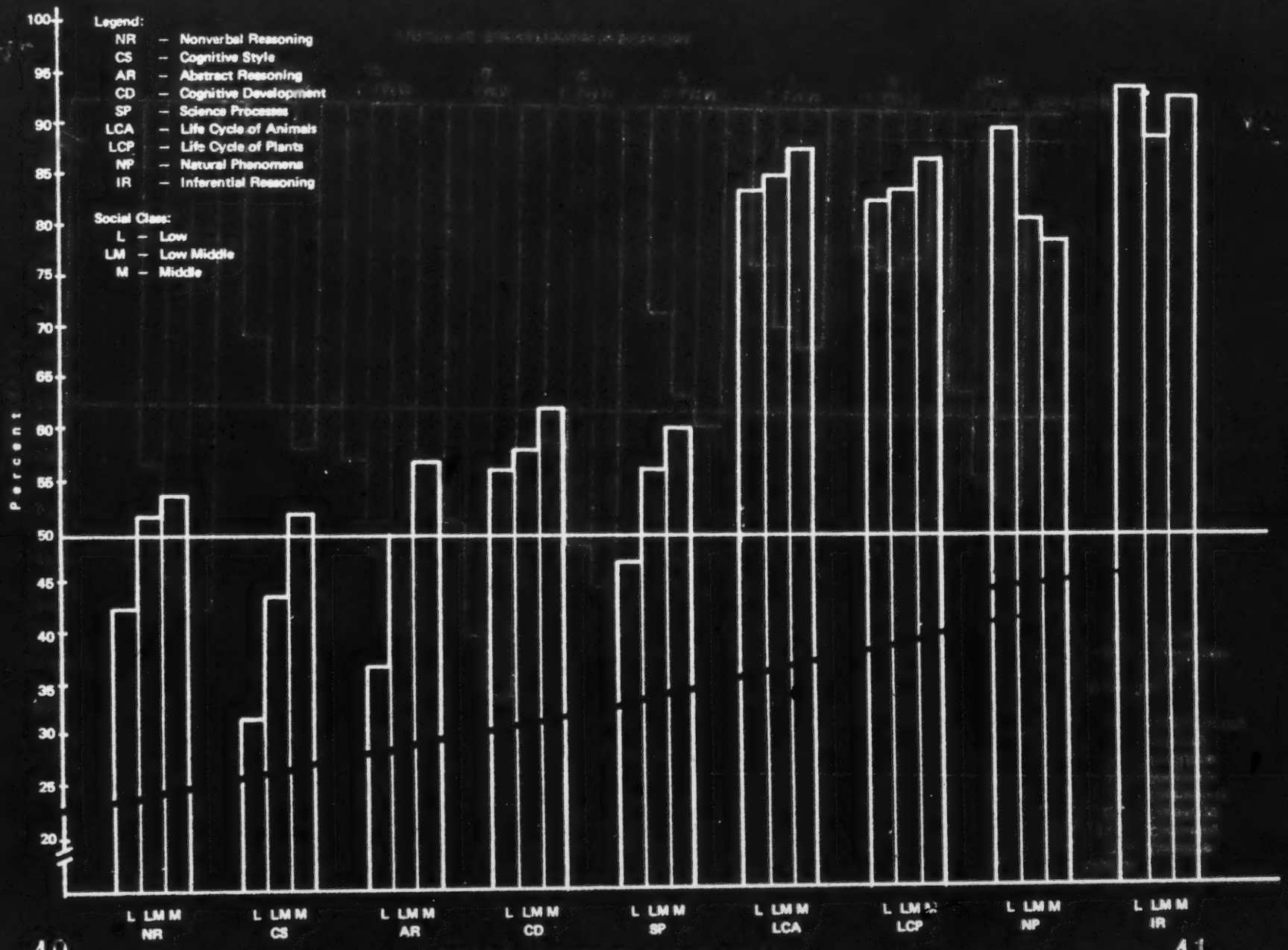

FIGURE 17. Cognitive Tests and Scales by Social Class

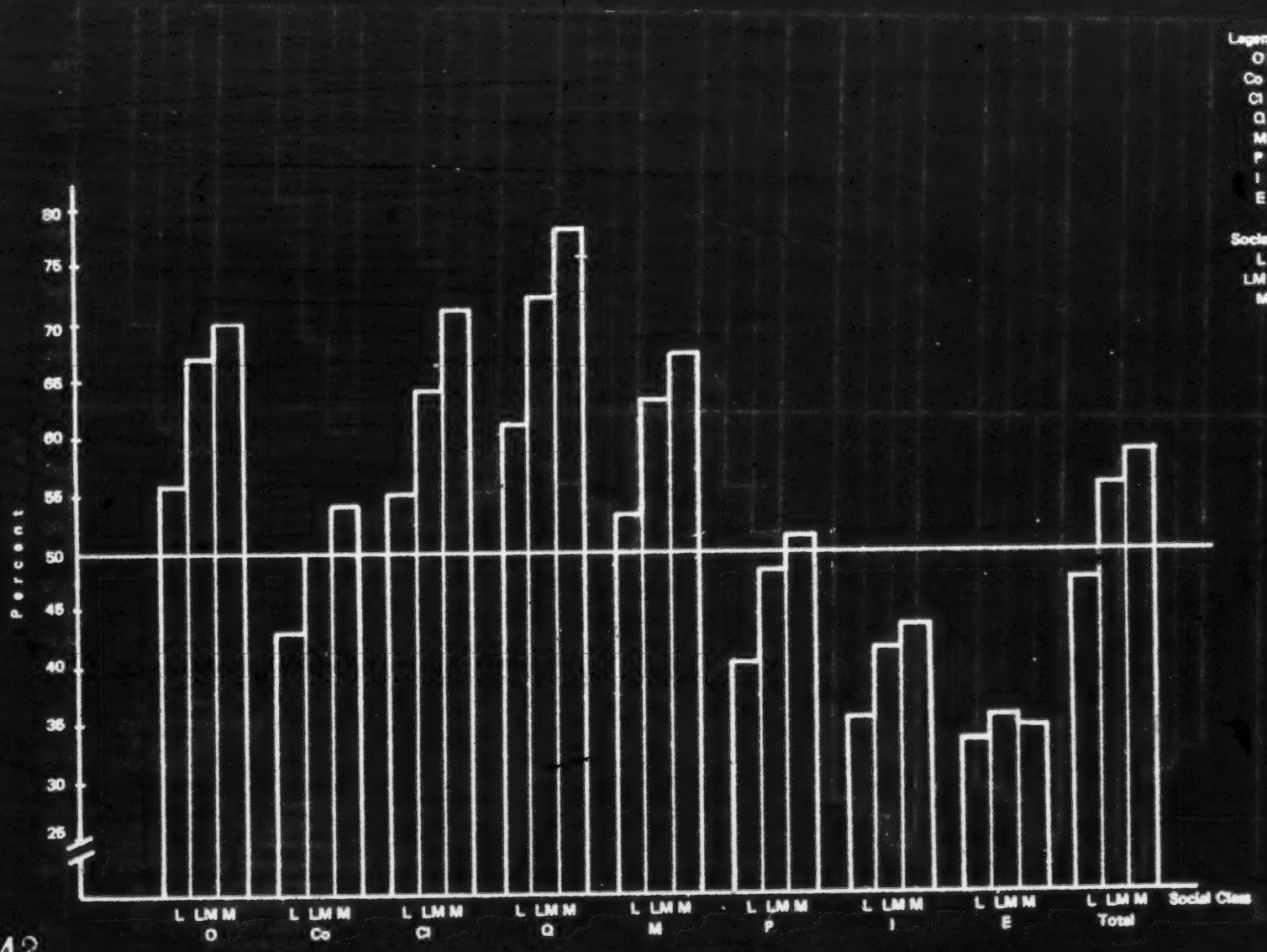

FIGURE 18. Science Processes by Social Class

understanding of life processes in animals and plants. natural phenomena, and social inferential reasoning. Lastly by comparison to the urban subgroup the rural adolescents have a better understanding of natural phenomena.

Consistent with expectations, more years in secondary school developed some of the cognitive abilities acquired of students for satisfactory academic performance. Nonverbal reasoning, more field independent style of responding, abstract reasoning, higher levels of cognitive development, and a higher level of understanding the science processes are associated with more years of secondary school. See Figures 15 and 16. But certain concepts are acquired by the adolescents even in first year and do not seem to improve with more years of secondary school. Understanding of life processes in plants and animals, natural phenomena, and social inferential reasoning are examples of these concepts and skills. And some skills are acquired by the adolescents probably from the earlier years of schooling. Adolescents even in first year have a firm grasp of understanding, observing, classifying, quantifying, and measuring. The other science processes like comparing are acquired only in third and fourth years, and the science process of predicting is acquired only in fourth year. Lastly, some science processes are not acquired even in fourth year, like inferring and experimenting.

Social class membership has been shown by this research to influence cognitive performance. Adolescents above the poverty level existence are better able to acquire nonverbal reasoning, a cognitive style more appropriate for science achievement, abstract reasoning, a higher level of cognitive development, and a better understanding of the science processes. See Figures 17 and 18. However, even the low class sample were able to acquire observing, classifying, quantifying and measuring.

One can conclude from the above results that the poor, rural adolescent is still capable of developing some cognitive skills and concepts. A cognitive deficit hypothesis is not supported by the data. The more plausible explanation is a cognitive difference. The poor rural adolescents develop other skills and concepts, and science and mathematics teaching can be made more relevant for these children if more attention is paid to more appropriate ways of teaching them.

RECOMMENDATIONS

Poor, rural children have been shown by this research to possess some cognitive capacities. They are not cognitively deficient, but they are cognitively different. There is therefore a need to utilize their strengths in the teaching-learning process to enable them to learn more efficiently.

First, these children are weak in abstract and nonverbal reasoning. Teachers must therefore utilize concrete props and actual experiences to teach abstract science ideas.

It is easy to say that more concrete experiences are needed for the students to understand abstract science ideas; it is harder to translate this principle into practice. Fortunately, there are several projects that do implement this principle, and the lessons they provide can serve as models. The textbook, Excursions in Teaching and Learning Science and Mathematics, (Hernandez and Fonacier, 1981) is one such effort. Video-tape recorded (VTR) lessons provide another example; these are especially useful for those concepts which are not readily observable in a pencil and paper format. The Center's current Physics book for secondary schools, Physics in Your Environment, (UPSEC, 1981) is another good example.

The difficulties in providing concrete examples for science lessons are compounded by the fact that laboratories and equipment are less likely to be available in the remote rural areas. The activities employed to illustrate science concepts should therefore make use of what is readily available in the environment. The use of improvised equipment in these localities is both appropriate and necessary. The current Physics textbook is based on such improvisations.

In addition, the Physics book summarizes each lesson visually with the use of a concept map. Since most of the science teachers in remote rural areas are not science majors, it is a big help even for their own understanding to provide a map of the interrelationships of the concepts and the structure of the lesson. The concept map tells the teacher which prerequisite concepts are needed to understand the lesson. It tells him or her how to sequence the discussions of the concepts and the activities. Thus, when students do not understand a lesson, one can determine from the concept map where they are.

This is an additional visual aid for both the student and the teacher.

In short, we need as many concrete props, visual aids, and actual experiences as possible to allow the rural children to understand abstract science ideas.

Second, we must make a distinction between higher science processes (including predicting, inferring, and experimenting) and lower science processes (observing, comparing, classifying, quantifying, and measuring). The urban-rural differences are more pronounced on the lower science processes, because on the higher science processes both groups failed to reach the 50 percent criterion for acquisition.

Rural adolescents acquire the processes of quantifying and observing with means slightly below 50 percent but insignificantly different from 50 percent, but they do not as a group acquire comparing and classifying, which are both achieved by the urban group. Lessons for rural adolescents should therefore focus on these two science processes before the treatment of predicting, inferring, and experimenting. Lessons in urban areas can focus directly on the higher science processes and one lower process--comparing--since the other lower processes are well understood by the urban students.

In short, we are recommending a certain amount of flexibility in the curriculum. The needs of the students seem to differ depending on where they are living. And science lessons can be planned to take these weaknesses into account.

Third, rural children are field dependent. They will benefit most from teachers who are warm and personalistic in their teaching styles. They will perform better if cooperative group work is utilized rather than a competitive individualistic approach. However they should be gradually introduced to field independent tasks to develop such skills in them.

Therefore there must be enough flexibility in the curriculum for teachers to make innovations in their teaching strategies as well as in content as is needed by their students. The Regional Science Centers should be maximally utilized to create curriculum materials that are more directly relevant in content as well as teaching techniques for particular regions. And help within the region

should be extended where it is most needed.

Fourth, since we are aware that rural adolescents are cognitively different, there is a need to investigate what else may be different. The framework they use to understand their world may also be different. Hence, investigations to identify alternative frameworks of children's misconceptions need to specify rural-urban differences among students. And in there research studies, the choice of the rural sample can benefit from the quantification techniques developed in two studies by Acuña (1981, 1983) to avoid impressionistic selection of the sample, which may be faulty.

And finally, another educational principle states that we need to understand the children we are teaching in order to be able to teach them effectively. We would like to recommend clinical interviewing as a technique for understanding adolescents, but this is obviously too time-consuming, and therefore an alternative should be recommended.

The use of free association as a research technique has already been used in investigating some science concepts like health. See Hernandez, 1981; Villavicencio, 1981). For purposes of understanding differences between rural and urban children, it is recommended that free association be utilized in mapping out conceptual differences.

We like to think that these techniques are already generally utilized by good teachers as a way of teaching more effectively. If, therefore, we could deploy the better teachers to the remote rural areas where the children need creative innovations, we may find drastic improvement in teaching and learning as a process. This is no different from a general who sends his best soldiers to areas where the battle is fiercest. However, the reality is that better teachers tend to get "promoted" to urbanized sectors of the educational system, and the remote rural areas are left with the less trained. This has to change--either by increasing the incentives for teachers who render service in the deprived regions or by rotating teaching assignments between the rural and urban sectors. There are, however, humanistic considerations that would be violated by this recommendation. Permanence and roots are important to the Filipino, and the teacher may be reluctant to uproot himself or herself once he or she has established residence.

We therefore need to develop the remote rural areas to attract better trained people into them. This of course is already a thrust of government. We have simply found further evidence for the wisdom of such a thrust.

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